Engineering the cell-material interface for controlling stem cell adhesion, migration, and differentiation.

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Funding Grants: A Novel Microenvironment-Mediated Functional Skeletal Muscle from Human Embryonic Stem Cells and their In Vivo Engraftment

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Scientific Abstract:
The effective utilization of stem cells in regenerative medicine critically relies upon our understanding of the intricate interactions between cells and their extracellular environment. While bulk mechanical and chemical properties of the matrix have been shown to influence various cellular functions, the role of matrix interfacial properties on stem cell behavior is unclear. Here, we report the striking effect of matrix interfacial hydrophobicity on stem cell adhesion, motility, cytoskeletal organization, and differentiation. This is achieved through the development of tunable, synthetic matrices with control over their hydrophobicity without altering the chemical and mechanical properties of the matrix. The observed cellular responses are explained in terms of hydrophobicity-driven conformational changes of the pendant side chains at the interface leading to differential binding of proteins. These results demonstrate that the hydrophobicity of the extracellular matrix could play a considerably larger role in dictating cellular behaviors than previously anticipated. Additionally, these tunable matrices, which introduce a new control feature for regulating various cellular functions offer a platform for studying proliferation and differentiation of stem cells in a controlled manner and would have applications in regenerative medicine.